WHAT WE CLAIM IS:

1. A subscriber modem apparatus that couples to an analog subscriber line and is operative to cooperate with a cooperative modem located across a digital network, the digital network being coupled to the subscriber line via a network line interface card, the subscriber modem comprising:

a remote-echo canceller coupled to receive a downlink training signal sent by the cooperative modem and to process the training signal in order to allow at least one parameter to be adjusted in the remote-echo-canceller, the remote-echo canceller operative to apply the at least one parameter to a downlink signal to produce a digital representation of a remote-echo cancellation signal, wherein the remote-echo cancellation signal is computed such that when it passes through the subscriber line and then combines with an echo signal at the input to an ADC (analog to digital converter) located within the network line interface card, a remote echo-cancellation error signal is produced at the input to the ADC in which at least some components of the echo signal have been substantially reduced, and wherein the computation of the parameter involves a first set of computations computed at the cooperative modem and a second set of computations computed in the subscriber modem;

a modem transmitter module which converts a bit stream into a digital representation of a modulated uplink signal; and

a combining unit which combines the digital representation of the modulated uplink signal with the digital representation remote-echo cancellation signal and couples the combined signal to a DAC (digital to analog converter) for subsequent coupling as an uplink analog signal onto the subscriber line to be transmitted to the ADC;

whereby the ADC thereby samples a signal comprising a superposition of the modulated uplink signal, the echo signal and the remote echo cancellation signal;

whereby the superposition of the echo signal and the remote echo cancellation combine to produce a remote echo cancellation error signal, a measure of which is reduced with respect to the echo signal.

2. The subscriber modem apparatus according to Claim 1, wherein the at least one parameter is adjusted in response to a command signal sent from the cooperative

modem, wherein the cooperative modem evaluates the remote echo error signal and generates the parameter adjustment command to cause the remote echo canceller to generate an improved remote echo cancellation signal that causes the measure of the remote echo cancellation error signal as observed at the ADC to be further reduced.

3. The subscriber modem apparatus of Claim 1, wherein the second set of computations involves generating a remote echo cancellation signal using a first parameter set so that the cooperative modem can evaluate the echo cancellation error signal and indicate how to adjust the at least one parameter.

4. The subscriber modem apparatus of Claim 3, wherein a block adaptive filtering algorithm is used to compute the parameter adjustment indication in the cooperative modem.

5. The subscriber modem apparatus of Claim 3, wherein a variant of the filtered-X LMS (FXLMS) algorithm is used to compute the parameter adjustment indication in the cooperative modem.

6. The subscriber modem apparatus according to Claim 1, further comprising:

an uplink training signal generator that causes an uplink training signal to be sent to the cooperative modem via the subscriber line and the digital network;

a processing function that causes the downlink training signal to be processed to estimate a set of parameters related to a downlink transfer function;

a processing function that causes the set of parameters related to the downlink transfer function to be sent back to the cooperative modem;

wherein the at least one parameter is adjusted in response to a command signal sent from the cooperative modem, wherein the cooperative modem uses at least the uplink training signal and the set of parameters received from the subscriber modem to generate the parameter adjustment command.

7. The subscriber modem apparatus of Claim 6, wherein the at least one parameter is further derived from another set of parameters that model a round-trip echo path from the cooperative modem through the line interface card and back to the cooperative modem.

8. The subscriber modem apparatus of Claim 7, wherein the downlink path is modeled as $H_2(z)$, the uplink path is modeled as $H_3(z)$, the round-trip echo path from the cooperative modem through the line interface card and back to the cooperative modem is modeled as $H_1(z)$, and the remote echo canceller is chosen to be a stable and causal approximation to $G(z) = -(\frac{H_1(z)}{H_2(z)H_3(z)})$.

9. A subscriber modem apparatus that couples to an analog subscriber line and is operative to cooperate with a cooperative modem located across a digital network, the digital network being coupled to the subscriber line via a network line interface card, the subscriber modem comprising:

a coupling to receive from the subscriber line a downlink training signal sent from the cooperative modem;

a digital signal processor operative to execute software functions in order to process a set of signals;

a software function operative to convert the downlink training signal into a set of downlink channel parameters which serve to parametrically model a downlink transfer function of a communication path extending from the line interface card to the subscriber modem via the subscriber line;

a software function that causes an uplink training signal to be coupled via the subscriber line to the cooperative modem to allow the cooperative modem to model an uplink transfer function;

a set of remote echo canceller parameters that are jointly derived using the downlink parameters derived in the subscriber modem and the uplink parameters derived in the cooperative modem;

a software function for use during normal data-mode operation, which causes the remote echo canceller to receive a downlink data signal, apply it to a digital filter, and generate a remote echo cancellation signal;

a combiner function to combine the remote echo cancellation signal with an uplink modem signal;

wherein when the combination of the remote echo cancellation signal and the

uplink modem signal traverse the uplink subscriber line transfer path and reach an ADC (analog to digital converter) located in the line interface card, whereby at least a substantial component of a downlink-to-uplink echo as seen at the input to the ADC in the line interface card is substantially reduced.

10. The subscriber modem apparatus of Claim 9, wherein the set of remote echo cancellation parameters are further derived from a set of parameters that model a round-trip echo path from the cooperative modem through the line interface card and back to the cooperative modem.

11. The subscriber modem apparatus of Claim 9, wherein the remote echo canceller is implemented as an FIR (finite impulse response) digital filter.

12. The subscriber modem apparatus of Claim 9, wherein the downlink path is modeled as $H_2(z)$, the uplink path is modeled as $H_3(z)$, the round-trip echo path from the cooperative modem through the line interface card and back to the cooperative modem is modeled as $H_1(z)$, and the remote echo canceller is chosen to be a stable and causal approximation to $G(z) = -(\frac{H_1(z)}{H_2(z)H_3(z)})$.

13. The subscriber modem apparatus of Claim 12, wherein the approximation to G(z) comprises a finite impulse response filter.

14. The subscriber modem apparatus of Claim 12, wherein the approximation G(z) is an infinite impulse response filter.

15. The subscriber modem apparatus of Claim 9, wherein the computation of the set of remote echo canceller parameters involves the solution to a least squares problem.

16. The subscriber modem apparatus of Claim 9, wherein the remote echo canceller involves the application of at least one of fuzzy logic computations and neural network computations.

17. In a communication system involving a digital modem coupled to a digital network, a line interface card that couples the digital network to a subscriber line, and a subscriber modem coupled to the subscriber line, a method of cooperative training used to converge upon a set of parameters for use within a remote echo canceller located in the

subscriber modem, wherein the converged set of parameters are iterated to substantially reduce a measure of an echo cancellation error signal as observed at an ADC (analog to digital converter) located within an uplink path of the line interface card, a method comprising:

at the digital modem, transmitting a training signal in a downlink direction to the subscriber modem wherein the training signal passes through the line interface card;

at the subscriber modem, receiving the training signal from the subscriber line, digitizing the training signal, and applying the digitized training signal to a remote echo canceller, wherein the remote echo canceller uses a present set of parameters in a parametric model to generate a remote echo cancellation signal, and coupling the remote echo cancellation signal via the subscriber line to the line interface card;

at the digital modem, receiving a set of values that correspond to a remote-echo-cancellation-error signal as digitized by the ADC within the line card and transmitted back to the digital modem via the digital network, wherein the remote-echo-cancellation-error signal is developed as a superposition of the downlink training signal and the uplink remote echo cancellation signal;

at the digital modem, computing a parameter adjustment to produce a modified set of parameters to be used in the remote echo canceller, wherein the parameter adjustment is estimated to reduce a measure of the remote-echo-cancellation-error signal, and transmitting an indication of the parameter adjustment to the subscriber modem;

in the subscriber modem, adjusting the set of parameters used in the remote echo canceller and readying itself to receive a subsequent training signal for a next iteration of adjustment.

18. The method of Claim 17, wherein a block adaptive filtering algorithm is used to compute the parameter adjustment in the digital modem.

19. The method of Claim 17, wherein a variant of the filtered-X LMS (FXLMS) algorithm is used to compute the parameter adjustment in the digital modem.

20. The method of Claim 17, wherein at least one of a block least squares algorithm, a block Shanno adaptive filtering algorithm, a block conjugate-gradient adaptive filtering algorithm, and a block least mean squares adaptive filtering algorithm is

used to compute the parameter adjustment in the digital modem.

21. The method of Claim 17, wherein the method comprises the application of at least one of fuzzy logic computations and neural network computations.

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